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AF/1765

[10191/1466]

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS AND INTERFERENCES**

Applicants : Volker BECKER et al.
Serial No. : 09/581,663
Filed : August 3, 2000
For : METHOD FOR PROCESSING SILICON BY ETCHING
PROCESSES
Examiner : Shamim AHMED
Art Unit : 1765
Confirmation No. : 4295

Mail Stop Appeal Brief-Patents
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**APPELLANTS' REPLY BRIEF IN RESPONSE TO
EXAMINER'S ANSWER (UNDER 37 C.F.R. § 1.193)**

S I R :

In response to the Examiner's Answer mailed on June 12, 2003
regarding the above-identified application, Applicants submit the following
arguments in support of the appeal of the final rejection.

ARGUMENTS

A. Rejection of Claims 33, 36-38 and 62 Under 35 U.S.C. § 103(a)

Claims 33, 36-38 and 62 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,313,836 to Fujii et al. ("Fujii") in view of publication Silicon Processing for the VLSI Era, Vol.1: Process Technology, S.Wolf and R. Tauber, Lattice Press 1986, ISBN 0-961672-3-7 ("Wolf") and in further view of U.S. Patent 6,211,092 to Tang, et al. ("Tang"). For the reasons stated below, the obviousness rejection of claims 33, 36-38 and 62 should be reversed.

In rejecting a claim under 35 U.S.C. § 103(a), the Examiner bears the initial burden of showing that there exists some suggestion or motivation to modify or combine the teachings of the applied references. In re Fine, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988). This teaching or suggestion to make the claimed combination must be found in the prior art and not based on the application disclosure. In re Vaeck, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991). In addition, there must be a reasonable expectation of success. In re Merck & Co., Inc., 800 F.2d 1091, 231 U.S.P.Q. 375 (Fed. Cir. 1986). If a proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. In re Gordon, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984). If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie obvious*. In re Ratti, 270 F.2d 810, 123 USPQ 349 (CCPA 1959); M.P.E.P. §2143.01.

The Examiner's obviousness conclusion with regard to claims 33 and 36 is premised on the following: a) Fuji's teaching of three separate etching processes, with the first etching process stopping upon reaching the at least one separating layer; b) Wolf's teaching of dry etching; and c) Tang's teaching of

using polymer-forming gas such as C_4F_8 for etch selectivity and providing side-wall passivation.

Initially, Applicants note that claims 33 and 36 recite a “first etching process” in which trenches are formed “by anisotropic etching.” While the Examiner contends that it would have been obvious to modify the teachings of Fujii by incorporating the dry etching process taught by Wolf, Applicants note that Wolf specifically teaches that plasma etching is *isotropic*. (See p. 541, Fig. 2 and lines 16-17). For at least this reason alone, one of ordinary skill in the art would not have found any motivation, let alone find any reasonable expectation of success, to use the plasma etching taught by Wolf in the etching process taught by Fujii, and further modify the combined teachings with the teachings of Tang, in an attempt to arrive at the claimed invention recited in claims 33 and 36.

Independent of the above, Applicants note that the Examiner is relying on Tang to support the conclusion that it is known in the prior art to achieve “a $(CF_2)_n$ film (20) being built up on side walls of the trenches (21)” as recited in claim 33, and “a $(CF_2)_n$ film (20) is deposited on . . . the freely accessible silicon surfaces and freely accessible silicon-oxide surfaces” as recited in claim 36. In this regard, Applicants previously noted in the Appeal Brief that the teachings of Tang are completely contradictory to the teachings of Fujii with respect to the etchings processes, thereby rendering the prior art invention being modified unsatisfactory for its intended purpose and changing the principle of operation of the prior art invention being modified, and in turn rendering the asserted obviousness conclusion invalid as a matter of law.

In response, the Examiner argues in the Examiner’s Answer that the asserted combination is appropriate because “Fujii et al.’s wet process is modified with Wolf et al.’s teaching of using dry etching over wet etching with important manufacturing advantage of eliminating handling, consumption and disposal of dangerous acids and solvent used in wet processing (see table on page 546 and 549 of Wolf et al.),” and therefore, “**m d i f i d F u j i i t a l .** is

compatible with the Tang et al.'s dry etching process." However, Applicants' arguments with respect to the asserted combination of Fujii, Wolf and Tang was not simply premised on the fact that Tang teaches a dry etching process and Fujii teaches a wet etching process: in addition to this obvious difference, Applicants had noted that the etchings processes of Fujii and Tang clearly employ completely ***different sets of etching steps***, and the addition of Wolf does not change the conclusion that the overall teachings of Fujii, Wolf and Tang would not motivate one of ordinary skill in the art to make the Examiner's selective combination of elements disclosed in these three references.

The Examiner's combination of Fujii, Wolf and Tang fails to consider the overall teachings of **all three combined references**. Instead, the Examiner initially considers Fujii and Wolf in isolation from Tang, and then considers the modified combination of Fujii and Wolf in conjunction with Tang. Applicants note that such piece-by-piece aggregation of components from multiple prior art references is legally incorrect. It is well established that the prior art references must be considered in its entirety, *i.e.*, as a whole, including portions that would lead away from the claimed invention. *See W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 U.S.P.Q. 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984); *see also, Akzo N.V. v. United States Int'l Trade Comm'n*, 1 U.S.P.Q.2d 1241, 1246 (Fed. Cir. 1986), *cert. denied*, 482 U.S. 909 (1987)(it is impermissible to ***pick and choose among individual parts*** of assorted prior art references as a mosaic to recreate a facsimile of the claimed invention).

The Examiner suggests that Fuji allegedly teaches the claimed limitations of "first etching process [in which trenches are formed by anisotropic etching] coming at least almost to a standstill upon reaching the at least one separating layer; . . . the separating layer subsequently being etched . . . by a second etching process, and a third etching process then etching the further silicon layer," as recited in claims 33 and 36. However, as mentioned above, Wolf explicitly teaches that plasma etch is isotropic, which is completely contrary to the claimed limitations, and Tang teaches two ***plasma etching***

methods which are both completely different from the **wet etching** method allegedly disclosed in Fujii, as well as being incompatible with the method recited in claims 33 and 36. “In a first preferred 2-substep sequence: a first, non-selective etch extends to below the upper stop layer; and a second, selective etch extends to and stops on the lower stop layer.” (Tang, col. 5, l. 43-45). “In a second preferred 3-substep sequence: a first, selective etch on average does not quite reach the upper stop layer; a second, non-selective etch punches through the upper stop layer; and a third, selective etch extends to and stops on the lower stop layer.” (Tang, col. 5, l. 45-50). Not only are the etching processes disclosed in Fujii and Tang **fundamentally different**, but the **specific etching sequences** disclosed in Fujii and Tang are completely different. Given these differences, it is unreasonable to suggest that one of ordinary skill in the art would be motivated to **selectively pick out** the specific teaching of Tang regarding the application of C_2F_4 film and combine it with the teachings of Fujii and Wolf.

In view of the above explanation, Applicants submit that the Examiner has done nothing more than selectively assemble the claimed elements from the applied references, using the Applicants’ specification and claims as a blueprint, which is a classic example of impermissible hindsight reconstruction. For at least these reasons, Applicants submit that claims 33 and 36, as well as their dependent claims 37, 38 and 62, are allowable over the combination of Fuji, Wolf and Tang, and the obviousness rejection of claims 33, 36, 37, 38 and 62 should be reversed.

Independent of the above, Applicants submit that claim 38 is not rendered obvious by the combination of Fuji, Wolf and Tang, for the following reasons. In support of the rejection of claim 38, which recites that “during the deposition of the $(CF_2)_n$ film (20), ionic bombardment is used which prevents the formation of the film (20) on all locations accessible for perpendicular ion incidence,” the Examiner once again summarily concludes in the Examiner’s Answer that “it would have been obvious that the ionic bombardment will prevent the formation of the polymer film on the locations accessible for

perpendicular ion incidence because all the constituents are similar as the claimed invention.” This assertion by the Examiner is nothing more than a classic example of a generalized assertion of “obvious to modify,” which does not properly support a §103 rejection. See In re Jones, 21 U.S.P.Q.2d 1941 (Fed. Cir. 1992). For this independent reason, claim 38 is allowable over the combination of Fujii, Wolf and Tang, and the obviousness rejection of claim 38 should be reversed.

B. Rejection of Claim 34 Under § 103(a)

Claim 34 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Fujii, Wolf and Tang, and in further view of U.S. Patent No. 4,310,380 to Flamm, et al. (“Flamm”). It is respectfully submitted that the combination of Fujii, Wolf, Tang and Flamm does not render claim 34 obvious for at least the following reasons.

To establish prima facie obviousness, three criteria must be satisfied. First, there must be some suggestion or motivation to modify or combine reference teachings. In re Fine, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988). This teaching or suggestion to make the claimed combination must be found in the prior art and not based on the application disclosure. In re Vaeck, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991). Second, there must be a reasonable expectation of success. In re Merck & Co., Inc., 800 F.2d 1091, 231 U.S.P.Q. 375 (Fed. Cir. 1986). Third, the prior art reference(s) must teach or suggest all of the claim limitations. In re Royka, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974). In addition, generalized assertions that it would have been obvious to modify the reference teachings do not properly support a § 103 rejection. See In re Jones, 21 U.S.P.Q.2d 1941 (Fed. Cir. 1992). The prior art references must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention. See W.L. Gore & Associates, Inc. v. Garlock, Inc., 721 F.2d 1540, 220 U.S.P.Q. 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984); *see also*, Akzo N.V. v. United States Int’l Trade Comm’n, 1 U.S.P.Q.2d 1241, 1246 (Fed. Cir. 1986), *cert. denied*, 482 U.S. 909 (1987)(it is impermissible to **pick and choose among individual**

parts of assorted prior art references as a mosaic to recreate a facsimile of the claimed invention). If a proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. In re Gordon, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984). If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie obvious*. In re Ratti, 270 F.2d 810, 123 USPQ 349 (CCPA 1959); M.P.E.P. §2143.01.

Claim 34 recites three separate etching processes, including a “first etching process” in which trenches are formed by “anisotropic etching,” and a “third etching process . . . etching the further silicon layer . . . wherein one of an isotropic plasma-etching process and an isotropic etching process with etching gases selected from the group xenon difluoride, chlorine trifluoride, bromine trifluoride, and iodine pentafluoride is used as a third etching process.” In support of the rejection of claim 34, the Examiner asserts that because Flamm teaches “that fluorine-containing gas such as chlorine trifluoride or bromine trifluoride is used to etch silicon isotropically at uniform and relatively high etching rate with respect to other such as silicon oxide, . . . it would have been obvious to . . . employ Flamm et al.’s teaching into modified Fujii et al.’s method for uniform and selective etching of silicon . . . [since, by doing] so, one could have a high etching rate at a relatively lower power levels and higher selectivity with excellent uniformity.” (Final Office Action, pp. 4-5).

First, with respect to the Examiner’s asserted modification of the teachings of Fujii by incorporating the dry etching process taught by Wolf, Applicants note that Wolf specifically teaches that plasma etching is ***isotropic***. (See p. 541, Fig. 2 and lines 16-17). For at least this reason alone, one of ordinary skill in the art would not have found any motivation, let alone find any reasonable expectation of success, to use the plasma etching taught by Wolf in the etching process taught by Fujii, and further modify the combined teachings with the teachings of Tang and Flamm, in an attempt to arrive at the claimed

invention recited in claim 34, particularly the limitation regarding the “first etching process” in which trenches are formed by “anisotropic etching.”

In addition to the above, the Examiner’s combination of Fujii, Wolf, Tang, and Flamm fails to consider the overall teachings of **all four combined references**. Instead, the Examiner initially considers Fujii and Wolf in isolation from Tang, and then considers the modified combination of Fujii and Wolf in conjunction with Tang, and subsequently applies the teachings of Flamm. Applicants note that such piece-by-piece aggregation of components from multiple prior art references is legally incorrect. It is well established that the prior art references must be considered in its entirety, *i.e.*, as a whole, including portions that would lead away from the claimed invention. *See W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 U.S.P.Q. 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984); *see also, Akzo N.V. v. United States Int’l Trade Comm’n*, 1 U.S.P.Q.2d 1241, 1246 (Fed. Cir. 1986), *cert. denied*, 482 U.S. 909 (1987)(it is impermissible to ***pick and choose among individual parts*** of assorted prior art references as a mosaic to recreate a facsimile of the claimed invention).

As mentioned above, Wolf explicitly teaches that plasma etch is ***isotropic***, which is completely contrary to the claimed limitations of claim 34 regarding the first etching process, and Tang teaches two ***plasma etching methods*** which are both completely different from the ***wet etching*** method allegedly disclosed in Fujii, as well as being incompatible with the method recited in claim 34. “In a first preferred 2-substep sequence: a first, non-selective etch extends to below the upper stop layer; and a second, selective etch extends to and stops on the lower stop layer.” (Tang, col. 5, l. 43-45). “In a second preferred 3-substep sequence: a first, selective etch on average does not quite reach the upper stop layer; a second, non-selective etch punches through the upper stop layer; and a third, selective etch extends to and stops on the lower stop layer.” (Tang, col. 5, l. 45-50). Not only are the etching processes disclosed in Fujii and Tang ***fundamentally different***, but the ***specific etching sequences*** disclosed in Fujii and Tang are completely different. Given these

differences, it is unreasonable to suggest that one of ordinary skill in the art would be motivated to **selectively pick out** the specific teaching of Tang regarding the application of C_2F_4 film and combine it with the teachings of Fujii, Wolf and Flamm.

In addition, while the Examiner contends that “it would have been obvious to . . . employ Flamm et al.’s teaching into modified Fujii et al.’s method for uniform and selective etching of silicon . . . [since, by doing] so, one could have a high etching rate at a relatively lower power levels and higher selectivity with excellent uniformity,” Applicants respectfully note that there is simply no motivation to specifically pick out the teachings of Flamm regarding the use of fluorine-containing gas for dry, isotropic etching of silicon and combine it with the selected teachings of Fujii, which deals with **wet etching**, let alone combine the selected teachings of Flamm with the selected teachings of Fujii, Wolf and Tang. This conclusion is inescapable, particularly when one considers the fact that: a) the Examiner is selectively applying the teachings of Wolf to the teachings of Fujii to incorporate plasma etching, which Wolf explicitly teaches as being **isotropic**, clearly contrary to the limitation of claim 34 that the “first etching process” is “**anisotropic**”; and b) the Examiner is selectively applying the teachings of Flamm for allegedly teaching the claimed “third etching process,” i.e., isotropic etching with gas. The overall teachings of Fujii, Wolf, Tang and Flamm, as applied by the Examiner, are internally contradictory in so many ways that an obviousness conclusion based on these four references simply cannot be sustained.

Applicants submit that the Examiner has done nothing more than selectively pick and choose the specific teachings from the applied references to achieve the claimed invention of claim 34, without any motivation that is derived from the overall teachings of the four applied references, Fujii, Wolf, Tang and Flamm. Accordingly, Applicants submit that the Examiner’s obviousness conclusion with respect to claim 34 is based on impermissible hindsight reconstruction, and the obviousness rejection of claim 34 should be reversed.

CONCLUSION

For the preceding reasons, it is respectfully submitted that the rejection of claims 33, 34, 36-38 and 62 under 35 U.S.C. § 103(a) should be reversed.

Respectfully submitted,

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Dated: 8/12, 2003

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